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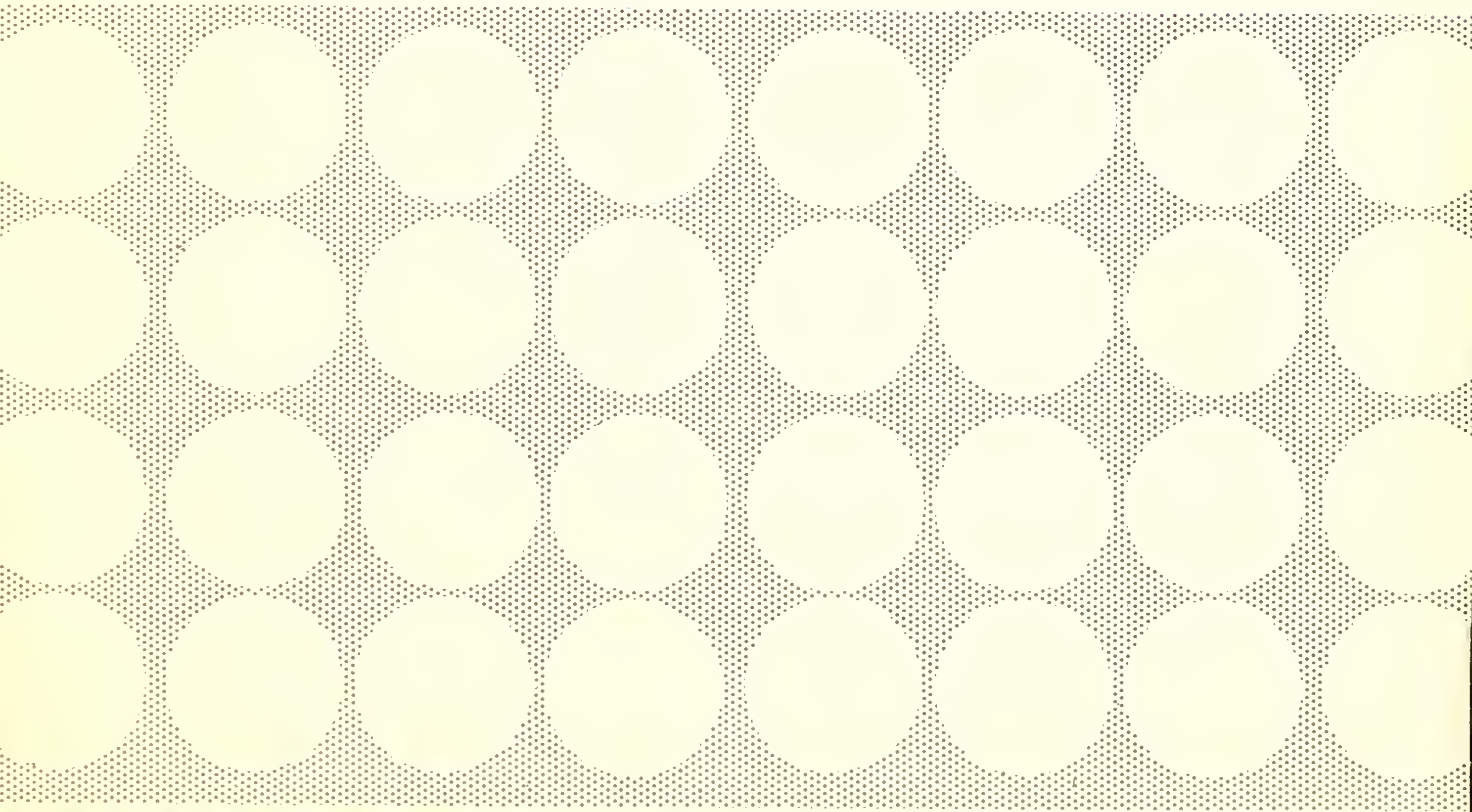
CROP-HAIL INSURANCE IN THE UNITED STATES



ECONOMIC RESEARCH SERVICE U. S. DEPARTMENT OF AGRICULTURE

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SUMMARY

Crops may be damaged or destroyed by many natural hazards, such as drought, freezing, flood, wind, insects, and hail. A farmer may lose all or part of his income if his crops fail. One hazard for which insurance is available is hail damage.

In 1963, farmers purchased more than $2.8 billion of protection against hail. This was double the amount purchased in 1951. About 75 percent of the total coverage was concentrated in three regions--the Corn Belt, Northern Plains, and Appalachian Regions.

Farmers are increasing their use of crop-hail insurance. From 1952 to 1963, the percentage of total crops covered by this insurance rose from 7.6 to 13.1 percent. Farmers in the Corn Belt had the highest coverage, 25 percent of their total crop value, and those in the Delta States the lowest, 1 percent. In 1963, corn, wheat, tobacco, soybeans, and cotton were the most heavily insured crops, accounting for 80 percent of the total insurance coverage.

Farmers have collected on their insurance anywhere from $35 million in 1952 to $81 million in 1962. The percentage of their net premiums returned as payments on losses varied from 94 percent of their premiums in 1956 to 46 percent in 1959. Farmers in all but two regions had at least one year in which 100 percent or more of their net premiums were returned to them in loss payments.

Losses paid per $100 of insurance coverage--the average loss-cost ratio--ranged from $7 in Wyoming to less than $0.50 in Mississippi and Alabama from 1952 to 1963. In general, this ratio decreased from North to South and increased both east and west from the Mississippi River. The areas with the larger loss-cost ratios tend to have less variability in losses than do areas with lower loss costs.

Crop-hail insurance is offered by mutual associations or cooperatives which are owned by its policyholders, stock fire and marine insurance companies, State hail insurance departments, and the Federal Crop Insurance Corporation as part of its all-risk insurance program. The Federal crop insurance differs from regular crop-hail insurance in that an individual must insure all acres of a particular crop in which he has an interest within the county; that it be purchased before planting; and that it cover production costs only.

The probability of hail, susceptibility of crops to hail damage, costs of production, and acres and value of crops produced are factors which may affect the use of crop-hail insurance. No one factor can fully explain the crop-hail insurance pattern.

Washington, D. C. September 1965

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CROP-HAIL INSURANCE IN THE UNITED STATES

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INTRODUCTION

Farming is a risky enterprise. A farmer's income may fluctuate widely because of changes in prices, costs, or production. Crops may be damaged or destroyed by drought, flood, winds, insects, disease, hail, or other natural hazards. Partial damage of crops may mean the loss of only part of the farmer's profit whereas total destruction means the loss of his investment in the crops as well.

The farmer has several alternatives in facing crop hazards. Good farming practices can reduce the damaging effect of some of them. Summer fallow, for example, helps protect soil moisture in areas of low rainfall. Diversification among crops with different maturities and with different susceptibilities to freezing, lack of or excess water, insects, and disease may reduce the likelihood of total crop loss from any one hazard.

In addition to the use of good farming practices, the farmer may provide for future losses by saving a little extra money every year. He may not want to take all of the risk himself however. Instead, he may want to take out insurance and pass part of this risk to an insurance company. If crop damage then occurs, his losses are reimbursed according to the insurance contract.

The principle of insurance is to take a number of natural events which have a probability of occurring and to pool the risks. Life insurance companies are an example of an insurance pool. They know that out of all those insured of a certain age, a given number will probably die, and these companies can plan their operations accordingly. The individual can not plan as well for himself. He has no pool with which to work. For him, the event either does or it does not occur.

Hail insurance is similar to the operation of a life insurance pool. An individual will either have hail damage or he will not. The hail insurance company estimates the probability of hail occurring and sets premium rates to reflect that probability. The early crop insurance companies were formed by local groups of people who wanted to pool their individual risks. Usually, all the members were then assessed to pay any losses which occurred. Although the idea was sound, the insuring pool was not extensive enough. The lack of geographic distribution of their risks made the local assessment organizations nearly as susceptible to any unusually large hailstorm as the individuals had previously been susceptible to losses from a small localized one. Modern crop-hail insurance organizations hold large pools of risks.

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[1] The author wishes to acknowledge the assistance of the Crop-Hail Insurance Actuarial Association, Chicago, Ill., the National Association of Independent Insurers, Chicago, Ill., the State Insurance Commissioners, and the many crop-hail insurance companies whose cooperation in providing data made this report possible.

From a small beginning in 1880, hail insurance on growing crops has become increasingly important to U. S. farmers. Since World War II, crop-hail insurance volume has tripled. However, not all areas of the United States have participated equally in this growth. Factors such as increasing costs of farming and changing crop values may explain part of the trend in crop-hail insurance. The trends in insurance coverage and in the percentage of the crop value insured, the variations in the relative crop damage, and the implications of each are examined in this report. Trends since 1952 are emphasized.

HAIL INSURANCE DEVELOPMENT

Crop-hail insurance is available from several sources, the oldest of which is the mutual association or cooperative which is owned by its policyholders. Many of the early attempts at offering crop-hail insurance were short-lived as little was known about the frequency or the variability of hail damage within an area. 2/

In 1880, tobacco growers in Connecticut organized the first mutual to offer crop-hail insurance. This mutual discontinued business after 7 years and was promptly followed by another hail organization in an adjoining county. No other specialized hail insurance appeared until 1889 when 4 mutual hail companies were reported in North Dakota. By 1900, 37 mutuals operating in 7 States collected approximately $643,000 in premiums and assessments and paid losses approaching $407,000.

By 1920, 121 mutual hail insurance companies had operated at one time or another. Of these, 80 had ceased operations by 1919. Of the remaining 41 companies, 15 started operations after 1915. The operating mutuals had a fourth of the $559 million insurance in 1919. In 1963, approximately 70 mutuals had roughly 43 percent of the $2.8 billion crop-hail insurance business.

Stock fire and marine insurance companies also offer crop-hail insurance although most of their insurance business is in other lines. Stock fire insurance companies first offered crop-hail insurance in 1883. By 1919, 43 stock companies received hail insurance premiums of more than $19 million, an $18 million increase from 1910. These companies had almost 50 percent of the $559 million business in 1919. By 1963, approximately 100 stock companies had slightly less than 56 percent of the total crop-hail business.

A third source of crop-hail insurance is the State hail insurance departments. North Dakota started the first State hail insurance department in 1911--more than 25 years after the first stock company began crop-hail insurance operations.

2/ The historical development of crop-hail insurance is taken from Valgren (8, pp. 2-11). (Underscored numbers in parentheses refer to Literature Cited, p. 18.)

Montana and Nebraska authorized similar departments in 1917 with Montana beginning operations immediately, and Nebraska beginning the following year. In 1919, South Dakota and Oklahoma provided for State hail departments with only South Dakota beginning operations. Of the original State hail insurance departments, only North Dakota and Montana still offer hail insurance. These States have been joined by Colorado.

The total insurance of the four State departments operating in 1919 was $139 million; more than 25 percent of the total U. S. business. The North Dakota, Montana, and Colorado departments had over $21 million (less than 1 percent of the total) in insurance coverage in 1963.

Protection against hail damage also is offered by the Federal Crop Insurance Corporation (FCIC) as part of its all-risk insurance program. Over time, hail damage has accounted for approximately 10 percent of the total loss payments of FCIC, or about $2.3 million in 1963 assuming it was an average year. The following analysis does not include FCIC data, but FCIC is briefly discussed in the last section of the report.

VOLUME OF CROP-HAIL INSURANCE PURCHASED

For most years since 1934, farmers have purchased increasing amounts of crop-hail insurance (table 1). The $2.8 billion protection carried in 1963 was more than twice the coverage in 1951 and cost farmers almost $109 million. 3/ During 1934, a depression and drought year, data indicate that crop-hail insurance amounted to only $87 million. 4/

The volume of crop-hail insurance purchased varied widely among regions, ranging in 1963 from $16.9 million in the Northeast to $1.3 billion in the Corn Belt (table 2). Premium cost ranged from $389,000 to $27.7 million (table 3). Also, the year-to-year purchases of crop-hail insurance varied more by regions than for the United States as a whole. While the upward trend in insurance coverage for the United States was interrupted in only 1 year after 1952, only the Appalachian Region had as few as 2 years with decreases. The Northeast, Southern Plains, and Pacific Regions had as many as 5 years each with a decrease in insurance purchased. In no year since 1952 have insurance purchases in all regions varied in the same way.

The $1.3 billion of crop-hail insurance in the Corn Belt in 1963 accounted for nearly half--47 percent--of the total U. S. business (table 4). Two States in the Corn Belt, Illinois and Iowa, had more than 80 percent of the total business in the region. The Northern Plains and Appalachian Regions had 13 percent each of the

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3/ Estimates for 1964 are: Liability, $2.9 billion; net premiums, $110 million; losses paid $68 million. Data on which these estimates are based were not received in time nor in sufficient detail to be included in the analysis.

4/ Since the data were not as complete during the earlier years of the series, the amount of hail insurance in force before 1952 may be underreported.

Table 1.--Hail insurance on growing crops: Amount of insurance, net premiums, and losses paid, United States, 1934-63 1/

Year	Amount of insurance 2/	Net premium 3/	Losses paid	Loss ratio 4/
	Million dollars	1,000 dollars	1,000 dollars	Percent
1934	87	3,117	1,777	57
1935	206	9,224	5,726	62
1936	167	5,969	2,780	47
1937	300	10,871	5,150	47
1938	318	13,357	9,602	72
1939	252	9,709	4,838	50
1940	243	9,170	3,573	40
1941	340	14,859	9,290	63
1942	476	20,694	13,018	63
1943	622	26,929	19,443	72
1944	805	34,898	21,893	63
1945	938	42,100	24,245	58
1946	973	42,502	16,990	40
1947	1,199	58,442	27,702	47
1948	1,288	53,732	28,511	53
1949	1,240	55,186	26,823	49
1950	1,057	40,057	16,710	42
1951	1,371	53,874	36,151	67
1952	1,589	65,539	34,927	53
1953	1,776	69,389	49,807	72
1954	1,896	72,575	54,485	75
1955	2,067	77,242	44,701	58
1956	2,117	78,095	73,130	94
1957	2,410	95,368	57,856	61
1958	2,452	103,815	54,655	53
1959	2,461	98,727	45,350	46
1960	2,495	103,022	59,945	59
1961	2,420	96,738	66,772	69
1962	2,651	108,087	81,402	75
1963 5/	2,817	108,766	70,802	65

1/ By mutual and stock insurance companies, and State hail departments.

2/ Partly estimated from premiums.

3/ After cash discounts and dividends.

4/ Losses as a percentage of net premiums.

5/ Preliminary.

Table 2.--Amount of crop-hail insurance in force, by farming region and by year, United States, 1952-63 1/

Year	North-east 2/	Lake States 3/	Corn Belt 4/	North-ern Plains 5/	Appa-lach-ian 6/	South-east 7/	Delta States 8/	South-ern Plains 9/	Moun-tain 10/	Pacific 11/	Total U.S. 12/
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1952	14,267	117,636	681,472	274,662	200,111	61,509	2,350	90,417	103,617	43,243	1,589,284
1953	20,295	141,263	816,220	271,690	203,565	62,391	4,122	73,003	126,408	56,771	1,775,728
1954	22,504	153,722	934,240	281,375	219,451	59,330	5,622	75,819	104,692	40,014	1,896,769
1955	27,052	162,523	1,018,926	263,333	253,261	67,602	7,630	81,566	129,521	56,039	2,067,453
1956	21,613	173,345	1,025,432	277,179	243,656	67,028	9,505	101,752	120,461	76,973	2,116,944
1957	17,893	193,371	1,087,633	366,706	230,021	59,749	11,965	159,093	159,728	123,972	2,410,131
1958	17,534	188,789	1,076,992	398,102	231,595	56,851	7,141	178,307	173,340	123,733	2,452,384
1959	15,409	193,434	1,138,856	375,488	248,099	66,853	8,272	153,333	159,917	101,084	2,460,745
1960	15,579	181,293	1,147,389	388,457	253,222	69,088	7,781	170,661	163,632	98,303	2,495,405
1961	14,839	163,177	1,128,504	322,945	289,409	75,953	8,418	170,082	146,785	100,319	2,420,431
1962	15,734	158,826	1,194,267	366,376	359,165	101,606	19,815	159,715	183,856	91,736	2,651,096
1963 13/	16,895	179,524	1,328,598	368,980	370,254	113,606	18,996	141,479	185,533	93,287	2,817,152

1/ Coverage partially estimated from premiums received.
2/ Maine, N. H., Vt., Mass., Conn., R. I., N. Y., N. J., Pa., Del., Md.
3/ Mich., Minn., and Wis.
4/ Ohio, Ind., Ill., Iowa, and Mo.
5/ N. D., S. D., Nebr., Kans.
6/ Ky., N. C., Tenn., Va., and W. Va.
7/ Ala., Fla., Ga., S. C.
8/ Ark., La., Miss.
9/ Okla., Tex.
10/ Colo., Idaho, Ariz., Mont., Nev., N. Mex., Utah, Wyo.
11/ Calif., Oreg., Wash.
12/ Detail may not add to total because of rounding.
13/ Preliminary.

Table 3.--Net premiums paid for crop-hail insurance, by farming region and by year, United States, 1952-63 1/

Year	Northeast	Lake States	Corn Belt	Northern Plains	Appa-lachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	Total U.S. 2/
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1952	814	4,169	13,134	20,539	9,178	2,617	69	7,215	7,007	796	65,538
1953	1,037	5,158	17,659	17,382	10,007	2,776	114	5,355	8,893	1,009	69,390
1954	1,175	5,488	20,733	17,915	11,024	2,708	147	5,424	7,038	924	72,576
1955	1,411	5,715	21,701	16,414	13,674	3,045	193	5,289	8,682	1,116	77,240
1956	966	6,219	22,958	16,415	13,204	3,014	265	6,739	6,807	1,507	78,094
1957	825	7,507	24,362	23,784	12,157	2,705	310	11,033	10,220	2,466	95,369
1958	797	7,780	23,931	28,995	12,083	2,643	186	13,298	11,471	2,631	103,815
1959	692	7,921	24,470	25,789	12,719	2,873	207	11,331	10,605	2,189	98,796
1960	623	7,899	25,238	28,404	12,431	2,969	191	13,055	9,992	2,221	103,023
1961	601	7,306	24,382	22,642	13,594	3,238	179	13,769	8,873	2,154	96,738
1962	641	7,169	26,925	26,520	16,897	3,903	405	12,596	11,019	2,012	108,087
1963 3/	697	8,039	27,734	25,659	17,628	4,537	389	11,247	10,858	1,978	108,766

1/ Net premiums are premiums after dividends. For States within a region, see footnotes 2-11, table 2.
2/ Detail may not add to total because of rounding.
3/ Preliminary.

Table 4.--Distribution of total crop-hail insurance coverage, by farming region and by year, United States, 1952-63 1/

Year	Northeast	Lake States	Corn Belt	Northern Plains	Appa-lachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	Total U.S. 2/
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1952	0.9	7.4	42.9	17.3	12.6	3.9	0.1	5.7	6.5	2.7	100
1953	1.1	8.0	46.0	15.3	11.5	3.5	.2	4.1	7.1	3.2	100
1954	1.2	8.1	49.3	14.8	11.6	3.1	.3	4.0	5.5	2.1	100
1955	1.3	7.9	49.3	12.7	12.2	3.3	.4	3.9	6.3	2.7	100
1956	1.0	8.2	48.4	13.1	11.5	3.2	.4	4.8	5.7	3.6	100
1957	.7	8.2	45.1	15.2	9.5	2.5	.5	6.6	6.6	5.1	100
1958	.7	7.7	43.9	16.2	9.4	2.3	.3	7.3	7.1	5.0	100
1959	.6	7.9	46.3	15.3	10.1	2.7	.3	6.2	6.5	4.1	100
1960	.6	7.3	46.0	15.6	10.1	2.8	.3	6.8	6.6	3.9	100
1961	.6	6.7	46.6	13.3	12.0	3.1	.3	7.0	6.1	4.1	100
1962	.6	6.0	45.0	13.8	13.5	3.8	.7	6.0	6.9	3.5	100
1963 3/	.6	6.4	47.2	13.1	13.1	4.0	.7	5.0	6.6	3.3	100

1/ For States within a region, see footnotes 2-11, table 2.
2/ Detail may not add to total because of rounding.
3/ Preliminary.

total business. The remaining 7 regions had the other 27 percent of the insurance coverage. Rhode Island, New Hampshire, Louisiana, and Nevada had negligible amounts of business . Although the proportion of the total business within any region varied considerably from year-to-year, there were no important shifts in position of the regions over time.

Insured Value of Crops

The variability of crop-hail insurance coverage from year-to-year--both regionally and nationally--may be partly caused by changes in the value of the crops grown. If the increase in total insurance corresponds with an increase in crop value, the percentage of the crop insured would not change.

Hail insurance is available for many crops. Not all crops can be insured in all areas, however. Insurable crops range from the cash-grains, feed-grains, tobacco, and cotton crops to truck crops, such as tomatoes, fruits, and berries. In 1963, the insurance on corn, wheat, tobacco, soybeans, and cotton accounted for almost 80 percent of the total insurance (table 5). The insurance on corn accounted for almost a third of the total. For these five crops,the percentage of the crop value insured ranged from 27 percent for tobacco to 7 percent for cotton.

Table 5.--Total amount of coverage of crop-hail insurance, percentage of total crop value insured, and susceptibility rank of crop to hail damage, by selected crops, United States, 1963

Crop	Coverage: Amount 1/	Coverage: Percentage of total 2/	Percentage of total crop value insured 3/	Susceptibility rank 4/
	Million dollars	Percent	Percent	
Corn	900	32	20	5/ 3
Wheat	490	17	22	5/ 3
Tobacco	350	12	27	1
Soybeans	290	10	16	2
Cotton	190	7	7	5
All other and unallocated 6/	600	21	---	---
Total	2,820	100	---	---

1/ Estimated. Rounded to nearest $10 million.
2/ Details do not add to total because of rounding.
3/ Based on crop values from: Crop Values: Season Average Prices Received by Farmers and Value of Production, 1962 and 1963, U.S. Dept. Agr., Statis. Rpt. Serv., Crop Rpt. Bd., CE-PR2-1-1 (63), Dec. 18, 1963.
4/ 1 means most susceptible . . . 5 means least susceptible to hail damage.
5/ Susceptibility--premium rates--approximately equal.
6/ Includes $120 million of unallocated coverage.

Premium rates of crop-hail insurance were examined for the five selected crops by small geographic areas to measure their susceptibility to hail damage. 5/ The crops were ranked from 1 to 5 in descending order of susceptibility to hail damage (table 5). The percentage of the crop value insured was directly related to its susceptibility rank in that the more susceptible crops had the larger percentage insured. Soybeans, the second most susceptible crop, was the only exception ranking fourth in the percentage of the crop value insured.

The amount of crop-hail insurance coverage increased faster than did the value of harvested crops from 1952 to 1963. For all regions, more of the crop value was insured in either 1962 or 1963 than in 1952 or 1953, indicating an increasing use of crop-hail insurance (table 6). The percentage of the total U.S. crop value insured increased from almost 8 percent in 1952 to 13 percent in 1963. 6/ The percentage of the crop value insured varied widely among regions, ranging in 1963 from more than 25 percent in the Corn Belt to only slightly more than 1 percent in the Delta States (table 6).

Part of the year-to-year variability in the percentage of the crop value insured may be influenced by the difficulty in estimating the future crop value for a particular year. Farmers probably estimate the future harvested value of their crops at the time crop-hail insurance is purchased. However, the actual harvested value of a farmer's insured crops may be quite different from his estimated value. For example, an unexpected drought or other hazard could seriously reduce production or crop value. If this occurred, the farmer would have a higher percentage of his crop insured than originally planned. In the Corn Belt in 1957, for example, insurance coverage proved to be large relative to value because poor harvest weather resulted in much soft corn of lower value than previously estimated.

The use of insurance also varied widely within regions. Within the Corn Belt, for example, the percentage of the crop value insured in 1963 ranged from 5 percent in Ohio to 40 percent in Illinois. The variation within this region cannot be fully explained by the difference in hail occurrence or by the types of crops grown.

5/ The probability of hail was assumed to be approximately equal within narrowly defined areas such as a county or a township. Within the defined areas, the differentials in crop-hail premium rates for the selected crops should, therefore, show variations in susceptibility to hail damage instead of variations in hail occurrence. The premium rates were then ranked for arbitrarily chosen counties of 12 widely scattered States.

6/ The total crop value includes the values of 78 different crops; only a portion of which are insured. Therefore, the changes in the insured crop value reflects the changes in the value of all crops, not just insurable ones, as well as changes in the amount of crop-hail insurance purchased. It is not known whether the increasing percentage of the crop insured is caused by either more crops being insured or by an increasing amount of insurance on currently insured crops. Either alternative indicates an increasing use of crop-hail insurance.

Table 6.--Percentage of total crop value insured, by farming region and by year, United States, 1952-63 1/

Year	Northeast	Lake States	Corn Belt	Northern Plains	Appalachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	Total U.S.
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1952	1.1	6.3	14.5	10.6	9.8	4.2	0.2	5.4	6.9	1.8	7.6
1953	1.7	7.9	18.5	12.9	10.7	4.1	.3	4.6	9.3	2.6	9.2
1954	1.8	8.6	21.6	13.2	11.4	4.8	.5	4.6	8.2	1.8	10.0
1955	2.5	9.7	23.7	14.4	13.5	4.3	.6	5.5	10.3	2.6	11.1
1956	1.8	9.5	23.3	15.5	12.2	4.7	.8	7.3	9.6	3.3	11.3
1957	1.5	12.2	28.5	18.2	14.5	4.7	1.3	11.0	12.3	5.5	13.9
1958	1.5	11.1	26.1	15.7	12.8	4.0	.8	9.5	13.1	5.6	12.8
1959	1.3	11.3	27.0	18.9	13.8	4.8	.7	8.8	11.5	4.2	12.9
1960	1.4	11.7	28.1	16.1	13.7	4.7	.7	9.5	11.8	4.2	13.1
1961	1.3	9.4	25.4	15.0	14.7	5.2	.7	8.7	11.0	4.3	12.3
1962	1.4	9.8	25.9	14.5	18.0	7.1	1.6	9.1	12.9	3.6	13.1
1963 2/	1.5	9.5	25.9	15.9	18.3	7.1	1.3	7.7	12.9	3.6	13.1

1/ Harvested value of crops; see footnote 3, table 5, and Agricultural Statistics, 1953-63. For States within a region, see footnotes 2-11, table 2.

2/ Preliminary.

Factors Affecting the Use of Crop-Hail Insurance

The occurrence of hail, and greater necessity to protect one's crop investment because of increasing costs or credit use, could affect the use of hail insurance. If hail occurrence was the most important factor, higher percentages of the total crop value insured would probably be in the Northern Plains and the Mountain Regions (fig. 1). 7/ Instead, these regions rank third and fourth, respectively. The susceptibility of different crops to hail damage and the changes in the acres grown of these crops may also contribute to the change in the use of crop-hail insurance.

Farming is more businesslike than ever before. While incomes per farm increased approximately 25 percent from 1952 to 1963, gross receipts increased more than 60 percent. The costs of production increased about 90 percent (7, pp. 6-11). The higher costs of production combined with the increasing size of farms may have made farmers more sensitive to the risks of hail damage. With costs increasing faster than income, hail damage could cause financial distress for some farmers. This is especially true since more of the costs are now cash costs. In some areas, it is not uncommon for lenders to strongly recommend hail insurance to protect both themselves and their borrowers.

The aggressiveness of insurance companies as well as greater awareness of the needs for insurance by farmers may also increase the use of hail insurance. A study of all insurance purchases by Vermont farmers indicated that the aggressiveness of insurance agents could be quite important (5, pp. 24-25). Of the farmers included in the survey, more than 50 percent had not been contacted for a selling interview in the year before the study. Perhaps the differences in the solicitation of farmers for insurance can partly explain intraregional differences.

An increase in insurance might be associated with an increase in crop acreage. But this was not true for 4 of the 5 major crops insured (table 5). From 1952 to 1962, the changes in the harvested acreage of the five crops were: Corn, 19-percent decrease; wheat, 39-percent decrease; tobacco, 31-percent decrease; soybeans, 93-percent increase; and cotton, 40-percent decrease (6, p. 452). The only increase in the number of acres exposed to hail was for soybeans and that alone would not account for the increase in insurance. Decreasing production and homogenization of certain tobacco types may explain part of the decline in the use of crop-hail insurance in the Northeast. An increase in the value of crop production would also be expected to cause an increased use of crop-hail insurance. But as illustrated in table 5, the use of crop-hail insurance has increased even faster than the total crop value.

HAIL LOSSES PAID FOR CROP DAMAGE

The frequency of hail varies widely across the United States and within States. The 1899-1939 average annual number of days with hail range from less than 1 day

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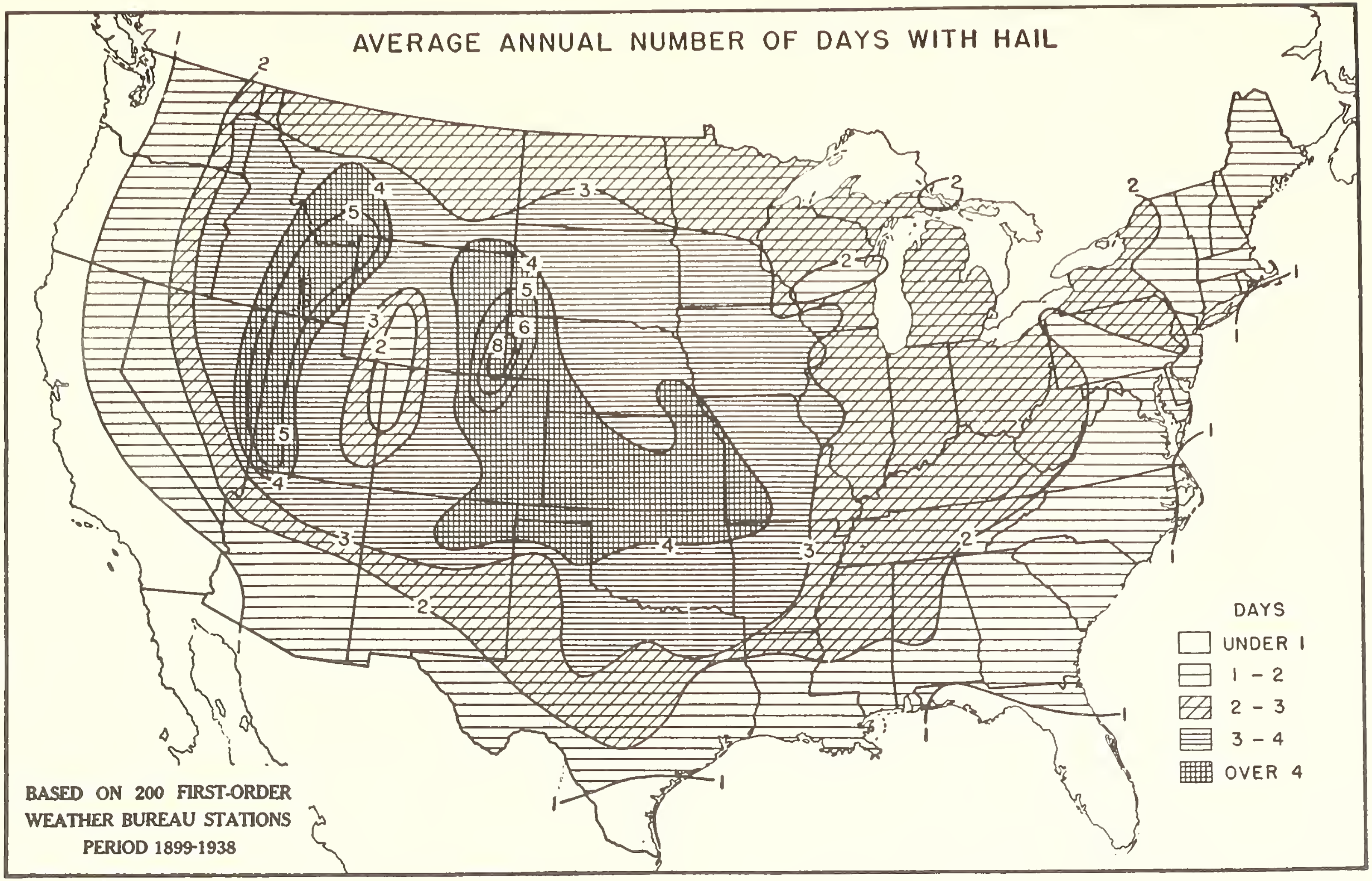
7/ The hail pattern shown in figure 1 is the only one available. Although the years covered are for 1899-1938, we believe this hail pattern is still valid and has not changed significantly.



Source: Yearbook of Agriculture, 1941.

Figure 1

along the Pacific Coast, southern Texas, and Florida to 8 days in western Nebraska and southeastern Wyoming (fig. 1). But parts of Wyoming had as few as 2 days with hail. In general, the frequency of hail is closely related to the amount of rain and to elevation (3, p. 56).

The frequency of hail does not fully explain the probability of crop damage. In some instances, hail occurs frequently in mountains or other areas where few, if any, crops are grown. Also, at some stages of crop growth it causes little damage. On the other hand, a single hailstorm can ruin a crop that is ready for harvest. Hailstorms are usually highly localized and crop damage may vary greatly within small areas. In addition, the frequency of hail may fluctuate widely from year-to-year.

The amount of hail losses paid to farmers in any one year depends on the amount of insurance coverage and the extent of hail damage. From 1952-63, payments for hail damage in the United States varied from a low of $35 million in 1952 to a high of $81 million in 1962 (table 7). More than a fourth of all crop-hail insurance payments in both 1962 and 1963 were in the Northern Plains.

The loss ratio--hail-loss payments as a percentage of net premiums--directly measures the percentage of total premiums returned, or by subtracting the ratio from 100, measures the aggregate cost to farmers. By comparing the year-to-year losses with the respective premiums, the effect of changes in the premiums caused by increased business is eliminated. The $35 million paid to farmers in 1952 was only 53 percent of total net premiums. The largest amount ever paid to farmers, $81 million in 1962, was 75 percent of net premiums (table 8). The highest loss rate was 94 percent in 1956.

Although the payments for hail losses and the loss ratio of the United States varied considerably from year-to-year, the variation among regions was much greater (tables 7 and 8). All regions except the Northern Plains and the Delta States had at least one year in which hail losses paid were equal to or greater than premiums (table 8). Loss ratios in the Northern Plains showed the least variability of any region with a low of 51 percent and a high of 99 percent of the premiums returned to farmers as loss payments. The Northeast showed the most variability of losses with a range from 19 to 168 percent.

Although the loss ratio measures the net premiums returned to farmers for hail damage in any one year, and indirectly measures the net cost to farmers, it is not a measure of the profits for hail insurance companies. The cost of salesmen's commissions, loss adjustment expenses, office overhead, profit, and the funds necessary to establish a reserve for a severe loss year--such as when all premiums are paid for losses--are not included in the loss ratio. Also, this ratio does not take into account the wide variations in experience between States within a region or between companies operating within a region.

The average "loss-cost" ratio--losses paid per $100 of insurance coverage--also measures the relative hail damage to insured crops. [8] In the long run, the loss-cost ratio, costs of the insurer, and the expected profit of the insurer determine the premium cost to farmers per $100 of hail insurance. The higher loss-cost ratios appeared in the Northern and Southern Plains, and in some States of the Mountain Region (fig. 2).

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[8] The average loss-cost ratio is an unweighted average of the yearly loss-cost ratios.

Table 7.--Payments of crop-hail losses to farmers, by farming region and by year, United States, 1952-63 1/

Year	Northeast	Lake States	Corn Belt	Northern Plains	Appa-lachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	Total U.S. 2/
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
1952-------:	345	3,296	6,621	10,447	8,243	1,435	24	1,516	2,854	146	34,927
1953-------:	660	3,255	21,138	11,049	5,528	987	66	1,871	5,129	125	49,808
1954-------:	1,974	2,752	17,743	10,707	12,975	1,307	74	2,204	4,522	227	54,485
1955-------:	1,811	3,392	7,225	12,113	8,230	1,806	118	4,526	4,617	863	44,701
1956-------:	379	8,049	28,496	16,281	8,828	2,038	88	3,504	4,509	956	73,128
1957-------:	491	7,158	7,344	18,599	3,736	1,024	111	11,020	6,057	2,317	57,857
1958-------:	166	4,294	9,839	18,271	2,772	619	8	6,610	9,113	2,961	54,653
1959-------:	133	7,198	6,304	14,734	3,917	1,279	45	7,638	3,960	151	45,359
1960-------:	176	4,253	14,660	18,050	6,188	1,402	16	9,221	5,724	254	59,944
1961-------:	755	6,768	17,460	12,474	8,958	2,857	166	10,379	6,302	655	66,774
1962-------:	633	4,754	18,581	20,662	10,620	4,016	212	10,217	11,092	614	81,401
1963 3/----:	288	5,946	12,687	18,506	10,166	4,981	149	6,481	10,723	876	70,803

1/ For States within a region, see footnotes 2-11, table 2.
2/ Detail may not add to total because of rounding.
3/ Preliminary.

Table 8.--Percentage of net premiums on crop-hail insurance returned to farmers as loss payments, by farming region and by year, United States, 1952-63 1/

Year	Northeast	Lake States	Corn Belt	Northern Plains	Appa-lachian	Southeast	Delta States	Southern Plains	Mountain	Pacific	Total U.S.
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1952-------:	42	79	50	51	90	55	35	21	41	18	53
1953-------:	64	63	120	64	55	36	58	35	58	12	72
1954-------:	168	50	86	60	118	48	50	41	64	25	75
1955-------:	128	59	33	74	60	59	61	86	53	77	58
1956-------:	39	129	124	99	67	68	33	52	66	63	94
1957-------:	60	95	30	78	31	38	36	100	59	94	61
1958-------:	21	55	41	63	23	23	4	50	79	113	53
1959-------:	19	91	26	57	31	45	22	67	37	7	46
1960-------:	28	54	58	64	50	47	8	71	57	11	58
1961-------:	126	93	72	55	66	88	93	75	71	30	69
1962-------:	99	66	69	78	63	103	52	81	101	31	75
1963 2/----:	41	74	46	72	58	110	38	58	99	44	65

1/ For States within a region, see footnotes 2-11, table 2.
2/ Preliminary.

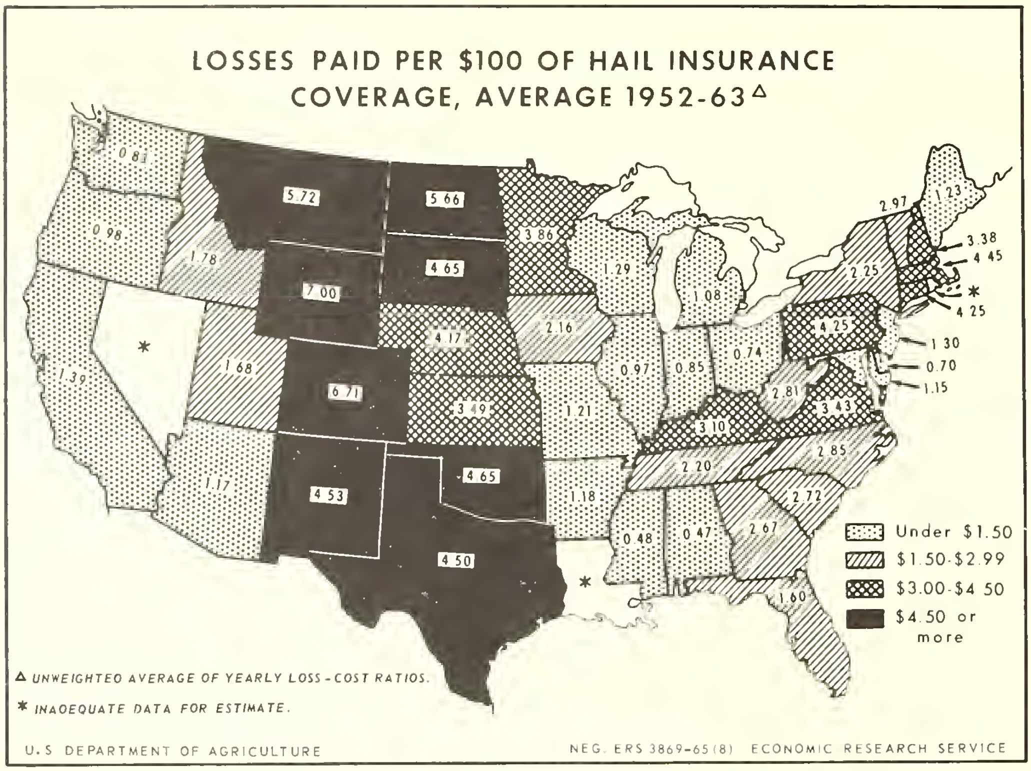

Figure 2

The 1952-63 average loss-cost ratios in the United States ranged from $7.00 per $100 of insurance in Wyoming to less than $0.50 per $100 of insurance in Mississippi and Alabama. In general, the loss-cost ratio decreased from North to South and increased west or east from the Mississippi River. The major exceptions are concentrated in the mountainous areas of the United States.

The coefficient of variation is a statistic which can be used to measure the year-to-year variability of the loss-cost ratios. 9/ In North Dakota, for example, the coefficient was 23 percent (fig. 3). This means that in approximately two-thirds of the years one might expect the loss-cost ratio to be within 23 percent of the $5.66 average--between $4.41 and $6.98. The coefficient of variation of 67 percent in Wyoming indicates that the loss-cost ratios would lie between $2.31 and $11.69 in two-thirds of the years. The larger the coefficient of variation, the larger the relative year-to-year variability in hail losses.

The coefficients of variation indicate that in the Plains States and in several States of the Mountain Region where the loss-cost ratios are high, they, nevertheless, are

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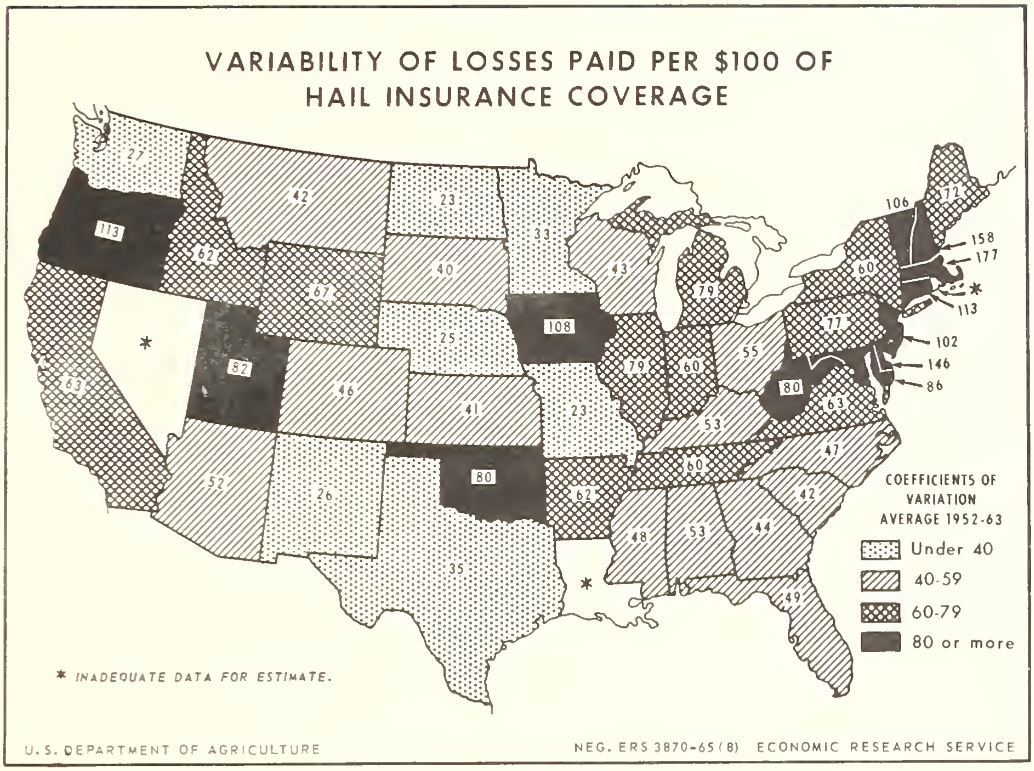
9/ The coefficient of variation is used to compare the variability of one series with the variability of another when the two series have different means. It is computed by dividing the standard deviation of the loss-cost ratio by the mean (average) of the loss-cost ratio and multiplying by 100.


VARIABILITY OF LOSSES PAID PER $100 OF HAIL INSURANCE COVERAGE
27
113
62
42
23
33
67
40
108
43
79
25
82
46
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177
113
102
146
86
*
*
*
COEFFICIENTS OF VARIATION AVERAGE 1952-63
Under 40
40-59
60-79
80 or more
* INADEQUATE DATA FOR ESTIMATE.
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3870-65 (8) ECONOMIC RESEARCH SERVICE

Figure 3

relatively stable from year-to-year. In contrast, variability is quite large in the Corn Belt--States with comparatively low average loss-costs.

The interpretation of the above figures is somewhat different for a particular area within a State. For example, from 1952 to 1963 the average loss-cost for Nebraska was $4.17 per $100 of insurance. This figure can also be assumed to represent the probable loss for every $100 of crop value exposed. With a coefficient of variation of 25, in two-thirds of the years losses would have been between $3.13 and $5.21. The average loss-cost ratio can be heavily weighted by a relatively small area of the State. Part of the intrastate variation in losses can be illustrated by the variation in hail insurance premium rates of a particular crop since premiums are then based on the likely occurrence of hail. In 1950, for example, the hail insurance rates for small grains in Nebraska varied from over $11 per $100 of insurance in the western part of the State to less than $3 per $100 of insurance in the eastern part of the State (1, p. 3). (See also figure 1 for hail occurrence.)

Average loss-cost ratios ranged from a low of $0.90 for the Pacific Region to a high of $4.58 for the Northern Plains (table 9). The standard deviation, the range around the average loss-cost ratio containing two-thirds of the ratios, and the coefficients of variation measuring the variability of the ratios are also given. In comparing the coefficient of variation of a region with the coefficients of variation of the States of the region, only Washington, California, Texas, Mississippi, Missouri, New York, and Maine had less variability than their respective regions. In addition, the variability of the loss-cost of the United States was less than that for each region except the Northern Plains.

Table 9.--Losses paid per $100 of crop-hail insurance coverage, standard deviation, coefficient of variation, by farming regions, average 1952-63

Region 1/	Average losses paid 2/	Standard deviation	Coefficient of variation
	Dollars	Dollars	Percent
Northeast	3.28	2.51	76.5
Lake States	3.01	.90	29.9
Corn Belt	1.40	.74	52.9
Northern Plains	4.58	.71	15.5
Appalachian	2.94	1.27	43.2
Southeast	2.56	1.03	40.2
Delta States	1.00	.56	56.0
Southern Plains	4.52	1.66	36.7
Mountain	4.13	1.10	26.6
Pacific	.90	.72	80.0
United States	2.56	.44	17.2

1/ For States within a region, see footnotes 2-11, table 2.
2/ Per $100 of insurance coverage.

As previously discussed, the basic idea of insurance is to collect all risk into a pool to smooth out the local variations of losses. On the basis of the coefficient of variation, it can be seen that, in general, the region had less fluctuation than its component States and the United States had less variability than its respective regions. As the geographic area increased, the variability of losses diminished.

FEDERAL CROP INSURANCE

In contrast to crop-hail insurance which insures only losses from hail, the Federal Crop Insurance Corporation (FCIC) insures losses from any natural hazard, such as drought, flood, insects, freezing, hail, and disease. The FCIC was first established by Congress in 1938 after a period of frequent and severe drought. Originally, only wheat was insurable by FCIC. In 1965, 23 different crops, including every major cash crop, were insurable. This insurance was available in 1,213 counties in 36 States. Not all crops were insurable in all counties in these States, however.

The losses paid by the FCIC because of hail damage are relatively small. A study based upon counties that were covered by Federal crop insurance from 1948 to 1959 showed that the causes of loss were: Drought, 41.6 percent; hail, 10.5 percent; insects, 10.2 percent; and all other causes, 37.7 percent (4, p. 39). The major causes of loss since 1939 for all counties have been: Drought, 39 percent; excessive moisture, 14 percent; insects, 11 percent; hail, slightly more than 10 percent; frost or freeze, 10 percent; all other causes, 16 percent (2, p. 8). Although hail ranked fourth in importance, approximately $2.3 million would have been paid to farmers because of hail damage in 1963 assuming it was an average year.

In addition to the differences in insurable hazards, a second major difference is the available protection. The total value of the crop is insurable with crop-hail insurance. The insurer may protect his profit as well as his production expenses. With all-risk insurance, however, only production expenses are insurable. Although more hazards are covered by FCIC, the losses suffered by the insured must be large enough so that at least part of the production costs are not recovered before the losses are reimbursed. For example, assume a production cost represented by 50 bushels an acre with an expected crop production of 75 bushels an acre at harvest. If hail destroys a third of the crop so that the harvested quantity is only 50 bushels an acre, the farmer would not receive a loss payment from all-risk insurance. If the crop is worth $1 per bushel and the total value was insured by crop-hail insurance, he would receive a loss payment of $25 for each insured acre. If drought or any other hazard destroyed more than the $25 (25 bushels) referred to above, all-risk insurance would pay all losses of production expenses whereas crop-hail insurance would pay only for hail damage.

A third difference is that the farmer must insure all acres of each all-risk insured crop in which he has an interest within the county (4, pp. 7-8). With crop-hail insurance, he can insure any field. If crops are damaged, all-risk insurance payments are usually determined by the insured's average per-acre loss on each insurance unit throughout the county. Extensive crop damage to one part of the insured unit may be offset by another part of the insured unit having an extra high yield. The total production may be greater than that necessary to cover production expenses. With crop-hail insurance, however, the damage is settled acre by acre regardless of what happened to the rest of the insured crop.

A fourth difference is that FCI must be purchased ahead of normal planting dates when expectations may be for a normal crop. Crop-hail insurance, however, can be purchased at almost anytime during the growing season. No reduction in premium rates occurs by delaying the purchase of crop-hail insurance since the crop value increases as harvest approaches. One reason for delaying the purchase of crop-hail insurance is for a more accurate evaluation of crops as the season progresses. A poor crop may not be worth insuring whereas a bumper crop may warrant the purchasing of extra insurance.

In summary, if financially possible and if area conditions warrant complementary coverage, farmers may want the protection of both all-risk and crop-hail insurance. FCIC compensates the farmer for his production cost losses caused by all natural hazards, whereas hail insurance can compensate all losses caused by hail. If hail destroys a crop covered by both types of insurance, loss payments can be collected from each. All-risk insurance must be purchased before the crop is planted, whereas hail insurance can be purchased at almost any time during the growing season. Whether one selects all-risk insurance, crop-hail insurance, or a combination of both depends upon the natural risks of the area, the individual's need for protection, and his financial situation.

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